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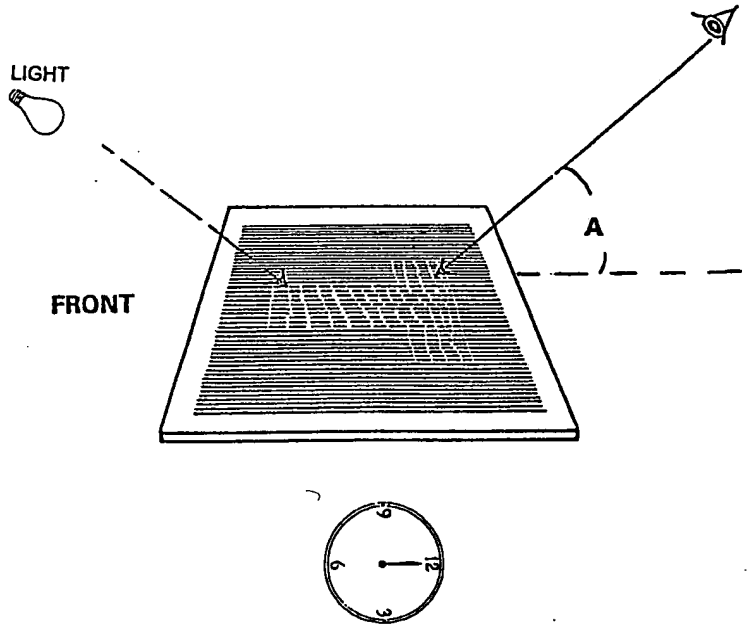
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(54) Title: INTAGLIO PRINTING METHOD AND SECURE DOCUMENT HAVING A VARIABLE OPTICAL IMAGE




(57) Abstract

Disclosed is a method for providing a security feature to documents via intaglio printing and the documents produced thereby. The process allows the printing of a variable optical image security message which enables the public to immediately determine the authenticity of the document by simple naked eye inspection, but which does not appear in a copy of the document when it is photocopied or transmitted via facsimile.

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# INTAGLIO PRINTING METHOD AND SECURE DOCUMENT HAVING A VARIABLE OPTICAL IMAGE

## FIELD OF THE INVENTION

The present invention relates to an improved method of providing a security feature to documents via intaglio printing and to the secure documents produced thereby. More particularly, the process allows the imprinting of a reflective security message which is immediately apparent to a casual observer, but which is not reflective in either a photocopy or a facsimile. The method avoids the use of photolithographic techniques to provide document security.

## BACKGROUND OF THE INVENTION

Several ways to reduce the chances of forging documents by methods, such as photocopying, already exist in the prior art. For example, U.S. Patent Nos. 4,227,720 and 4,310,180 disclose a system for protecting photolithographically prepared documents which employs a masked warning mark that is said to clearly appear only on copies due to the inability of color copiers to integrate a composite pattern of big and little dots. On the original document, the mark is at least partially concealed from the casual observer. The system utilizes a mask having small dots of color density below the color reproductive density of the copier, while the overlay of the mask and warning phrase has large dots of color density that exceeded the color reproductive density of the copier. Since the copier cannot resolve the very fine screened dots which make up the warning phrase, the area generally appears as white on the copies it

produces. Depending on the quality of the printing and the copier, it was observed that in some cases the warning mark does not always clearly appear when a document is photocopied.

Also well-known in the prior art are methods for accurately printing very fine lines and other elements, such as intaglio printing, which is generally illustrated in Fig. 1 and discussed further below. Intaglio printing has been used previously to imprint security images into documents of value as disclosed in U.S. Patent No. 4,033,059. In that patent, the pattern elements defining the image portions differ in depth or orientation from those elements forming the background. The object is to make a document in which the ability to discern the image portion from the background varies noticeably depending upon the angle of view and the orientation of the document, a characteristic not passed on to copies of the document. Both latent and transient images can be used to achieve this object. As viewed from a direction normal to the document surface, the latent image blends visually with the background. However, when the document is viewed at an acute angle to its surface, the latent image is readily recognizable in contrast to the background. The transient image is discernable when the document is viewed from a direction normal to its surface but disappears as the angle of view becomes acute. Whether a transient or latent image is used, copies of the document will not have the characteristic of a changing relationship between the image portion and the background as a function of changing angle of view. Conversely, as shown in U.S. Patent No. 1,002,600, it is also known to provide distinctive marks which consist of lined elements produced at angles to the lines of the ground-work, which marks are "invisible" except when inspected through a special detector.

Our co-pending application, entitled "Printing Method and Copy-Evident Secure Document," provides a further improvement on printing methods for providing a copy-evident

security feature to documents. In that application, a unique design composed of horizontal and diagonal or vertical lines is impressed into a document substrate via one of several printing methods, such as intaglio or lithographic printing. The design is difficult to see with the naked eye when making a casual inspection of the document, but it becomes immediately apparent in a copy if the document is photocopied or reproduced via facsimile.

SUMMARY OF INVENTION

It is the principal object of this invention to provide an improvement on the well-known method of intaglio printing in order to produce an original document that cannot be readily reproduced by methods, such as photocopying or facsimile reproduction.

Another goal of this invention is to print an original design or pattern onto secure documents so as to enable the public to immediately determine the authenticity of the documents by simple naked eye inspection. This objective is accomplished through the creation of a variable optical image through intaglio printing with reflective ink, as discussed further below. By permitting direct visual authentication of the document, the invention, which can be used independent of or in combination with other security techniques, counteracts the attempts of counterfeiters to use photographic, color copier techniques, facsimiles, or scanning devices to counterfeit documents. The present invention also eliminates the need for a separate photolithographic process to be used in conjunction with the intaglio printing process to provide additional security features.

The invention is directed to the imprinting of a pattern with reflective intaglio ink onto a substrate, such as paper, so that an embossed or raised effect is achieved without the creation of stress on the substrate. The utilization of reflective ink permits light to be reflected off of the sides of each of the raised impressions. As a

result, one may obtain different images of variable intensity which are readily identifiable with a simple manipulation of the document. Another benefit of this process includes the longevity of the produced documents, specifically that the creation of ink buildup via the intaglio process will not flatten, unlike the products made by simple embossing, but rather will retain its initial raised configuration and thereby retain its self-authenticating features.

There are many uses of this invention. For example, the authenticity of the following types of documents can be verified by simple visual inspection and manipulation when such documents are prepared by the intaglio printing technique of the present invention: 1) printed documents with monetary value, such as banknotes, travelers checks, savings bonds, gas coupons, restaurant tickets, postal and fiscal stamps, checks, bankcards or other credit cards; 2) identification documents, such as passports, identification cards, visas, ownership certificates, stocks, bonds, raw material certificates, titles, birth and death certificates, voting cards, personnel badges, or fiscal vignettes; and 3) ticketing and labeling documents, such as tickets to control the flow or identification of people (e.g., Olympic Games tickets), lottery or game tickets, travel tickets, or security labels for trademark verification (e.g., to identify champagne). A variation of the above-mentioned uses of the invention permits the integration of a simple message that correlates with another printed element of the security document, for example, the first character of the serial number or the vintage year found on a champagne label may be the hidden message. This list of uses and variations is merely exemplary and not meant to be construed as limiting.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates the prior art intaglio printing process;

Fig. 2 is an enlarged view of the paper before and after it passes between the impression roller 6 and the plate cylinder 10;

Figs. 3a and 3b demonstrate ink placement in horizontal and vertical lines on the intaglio printed document;

Fig. 4 demonstrates the view at angle A from the side of the flat document, whereby an impressed "T" image design is visible;

Fig. 5 demonstrates an alternative view of the document whereby the composite design is obscured; and

Fig. 6 demonstrates yet another alternative view at angle A from the rear of the document whereby the incident light is reflected off of the lines of the background design towards the observer.

DETAILED DISCUSSION

As illustrated in the intaglio process of Fig. 1, the ink fountain 1 supplies ink to several intermediate transfer rollers 2 that act to even out the supply flow of ink. A final ink transfer roller 3 which has a geometry that follows the surface of the printing plate 4 then fills the plate with ink. A wiping roller 5 utilizes a chemical wiping system 9 or wiping paper to wipe the excess ink off the surface of a plate or several identical plates 4, leaving ink in the intaglio portions i.e., those portions which have been etched, of the printing plate 4. When paper, or another document substrate having a flat surface 7, passes between the impression roller 6 and the plate 4 located on the cylinder 10, the ink is transferred from the intaglio lines of the plate 4 to form raised lines of ink on the paper, as shown in cross-sectional view by triangles 8 in Fig. 2 (not drawn to scale).

Attached to the plate cylinder 10 are one or more identical plates 4 that makeup the design which is to be printed on the paper. The die or matrix of the printing plate 4, which can be composed of copper, steel, or any

other metal commonly used by high security engravers for intaglio printing, can be etched to different depths.

Traditionally, the original designs used for security purposes were created by security printers using a drawing technique known as "linework" as discussed below. A composite design results from superimposing a distinct, original engraved image on another image while the orientation of both images is maintained. Thereafter, both images are incorporated and preserved in the same original master.

More frequently, the metal printing plate is engraved by chemical etching, which consists of exposing the drawing onto a film that itself is later transferred onto a photoresist on the metal plate. Specifically, certain insulated areas of the metal, which are protected by exposed photoresist, are not attacked by the acid used in etching and therefore the metal plate remains protected from the acid in these areas. The unexposed photoresist is washed off, and the acid etches into the metal surface of the plate either a tapered or V-shaped format depending upon the width of the lines. For example, a line having the width of .05 mm will render a depth of around 30 microns. An additional factor which effects the depth of the engraving is the amount of contact time between the acid and the metal plate. As a result, the drawing is etched into the metal printing plate.

In the alternative, manual or hand engraving using a graver or dragging tools may also be utilized to render a line depth of 20 to 130 microns in the metal. These and other techniques for preparing the intaglio plates are well known to those skilled in art and as a result are not discussed further herein.

As shown in Fig. 2, after the printing plate 4 is wiped by the wiper roller system or wiping paper system 5, the highly viscous ink residue resides only in the recesses 11, i.e. intaglio portions, of the engraved printing plate 4. The paper 7, which passes between the pressure cylinder 6

and the plate cylinder 10, is thereby pressed into the ink-filled recesses 11 of the engraved plate 4 so as to replicate the pattern of the plate 4 in a raised impression 8 on the side of the paper adjacent to the printing plate 4. The transfer gives a different result depending on the depth and style of the line on the plate. Typically, the ink depth will be 50% of the line impression height, but this depth varies widely depending on the paper. The overall amount of ink may vary between 15 to 50 microns.

This invention employs the well-known intaglio printing process as previously described and shown in Figs. 1 and 2, modified as described below. As shown in Fig. 3a and 3b, lines of various dimensions and angular positions may be produced on the document, the line dimensions depending upon the width and depth of the lines engraved in the plate. On Fig. 3, the lines are shown as horizontal and vertical but of course may be set at other angular positions with respect to each other. Depth is defined as the height to which the lines project in a direction perpendicular to the surface of either the substrate or the printing plate. Typically, each image is cut using between 30 to 200 lines per inch. Line widths of .002 to .003 inches may be used.

Various designs may be superimposed to form the actual composite design that is then engraved into the metal plate 4, preferably by chemical means. Alternatively, the composite design may be engraved into the metal plate via any of the techniques well known in the art. For example, Fig. 4 shows a composite design 12 which is made up of an image design 13 bordered by a background design 14. The image design, illustrated as a "T" shaped design on Fig. 4, is made up of horizontal lines 15. The background design 14 is made up of vertical lines 16 in the area excluded by the "T" image design 13. The image design 13 and background design 14 are superimposed to form the composite design 12. After engraving the composite design 12 into the metal printing plate 4, the plate is then rounded into a

cylindrical configuration and attached to the plate cylinder 10.

Reflective inks, such as silver ink, which possess mother of pearl, aluminum or any other reflective pigments are utilized in the invention. The finish imparted to the substrate surface by these inks depends upon the overall percentage of reflective pigments in the ink as well as the properties of the document substrate. For example, an ink mixture having 25% aluminum particles will give a shiny, varnished look to a document substrate. Additionally, products that aid in drying or solvents which stabilize the whole ink composition may also be added to the intaglio ink mixture. The utilization of such reflective inks permits light to reflect off of the sides of the raised impressions.

As the paper 7 passes through the intaglio printing process of Fig. 2, the composite design 12 is impressed into the document substrate. Depending upon the angle of view of the observer with respect to the plane of the document and the angular position of the observer with respect to the document, the relative intensity of the image design with respect to the background design will change. For example, if the observer views the "T" image design 13 from the side of the paper document (i.e. the 3 o'clock position) at angle of view A as shown in Fig. 4, the light incident on the image design 13 is reflected off of the sides of its horizontal lines 15 towards the observer. Angle of view A is the angle between the flat substrate surface and the viewer, which preferably is not equal to 0° or 90°. The vertical lines 16 of the background design 14, by contrast, will appear darker and substantially blend with the surface since most of the light incident on the background design is reflected away from the observer. However, as shown in Fig. 5, if the observer's angular position with respect to the document shifts towards the back of the document (i.e., towards the 12 o'clock position), the intensity of the "T" design changes because less light is reflected off of the horizontal lines in the direction of the observer. When the

observer reaches an angular position of 45° with respect to the lines of the image design 13 (i.e. the 1-2 o'clock position), the light reflected from both the image design 13 and the background design 14 towards the observer is substantially equal and the composite design 12 is obscured. Finally, if the observer is positioned behind the document and views the composite design 12 from the back of the document (i.e. the 12 o'clock position) as shown in Fig. 6, only the light incident on the lines 16 of the background design 14 is reflected in the direction of the observer, thereby leaving the "T" image design 13 comparatively darker than the background design 14. Alternatively, results opposite in contrast may be achieved if the lines of the image and background designs are shifted by 90°.

It is to be noted that for a simple image design such as that shown on Fig. 4 as the "T" design 13, it is preferred that the lines of the image design and the line of the background design are perpendicular. Such a perpendicular arrangement affords the best contrast between the image design and background design when the composite design is viewed parallel to either the lines of the image or background designs. As the angle between the lines of the image design and background design is changed from 90°, the resulting contrast becomes more subtle. The chosen angle between image and background lines must be sufficient so that it is possible to view the document in at least one angular position (i.e. clock position) in which most of the light incident on the image design is reflected towards the observer and most of the light incident on the background design is reflected away from the observer thereby making the image design easy to discern. The chosen angle should also satisfy an additional criterium. There must be another angular position in which the light reflected from both the image design and the background design is substantially equal thereby obscuring the composite design.

Since this phenomenon of the variable optical image cannot be replicated in documents reproduced by a copier or a facsimile machine, a casual observer can immediately recognize the authenticity of a document based upon the presence of the variable image.

I claim:

1. A secure document having a variable optical image comprised of:

a document substrate having a surface;

a composite design on said surface comprised of an image design bordered by a background design;

said image design and said background design are each comprised of parallel solid intaglio print lines of reflective ink on said surface, with the lines of said image design being offset at a sufficient angle to the lines of the background design so that it is possible to view such document in at least one angular position in which most of the light incident on the image design is reflected towards the observer and most of the light incident on the background design is reflected away from such observer and at least one other angular position in which the light reflected from each of the image design and background design towards the observer is substantially equal thereby obscuring the composite design.

2. A security document as set forth in Claim 1, wherein the lines of said image design are perpendicular to the lines of said background design.

3. A security document as set forth in claim 1, wherein the lines of said composite design have a pitch of between 30 and 200 lines per inch.

4. A security document as set forth in claim 1, wherein the lines of said composite design have a width of .002 to .003 inches.

5. A security document as set forth in claim 1, wherein the reflective ink comprises 25% by weight aluminum.

6. A security document as set forth in claim 1, wherein the reflective ink contains mother of pearl.

7. A security document as set forth in claim 2, wherein the lines of said composite design have a pitch of between 30 and 200 lines per inch.

8. A security document as set forth in claim 2, wherein the lines of said composite design have a width of .002 to .003 inches.

9. A security document as set forth in claim 2, wherein the reflective ink comprises 25% by weight aluminum.

10. A security document as set forth in claim 2, wherein the reflective ink contains mother of pearl.

11. An intaglio printing method of producing a security document comprising:

transferring reflective ink to at least one intaglio printing plate having a surface engraved with a composite design,

said composite design comprising an image design bordered by a background design, wherein the surface of said transfer roller corresponds to that of said printing plate,

said image design and said background design are each comprised of parallel solid intaglio lines with the lines of said image design being offset at a sufficient angle to the lines of said background design so that it is possible to view the resulting document in at least one angular position in which most of the light incident on the resulting image design is reflected towards the observer and most of the light incident on the resulting background design is reflected away from such observer and at least one other angular position in which the light reflected from each of the resulting image design and resulting background design towards the observer is substantially equal thereby obscuring the resulting composite design;

wiping the excess ink off of the printing plate surface;

pressing a document substrate into the plate thereby transferring the ink from the plate surface to the document substrate so that a raised impression is produced on the document substrate.

12. The intaglio printing method as set forth in Claim 11, wherein the lines of said image design are perpendicular to the lines of said background design.

13. The intaglio printing method as set forth in claim 11, wherein the lines of said composite design have a pitch of between 30 and 200 lines per inch.

14. The intaglio printing method as set forth in claim 11, wherein the lines of said composite design have a width of .002 to .003 inches.

15. The intaglio printing method as set forth in claim 11, wherein the reflective ink comprises 25% by weight aluminum.

16. The intaglio printing method as set forth in claim 11, wherein the reflective ink contains mother of pearl.

17. The intaglio printing method as set forth in claim 11, wherein the lines of the composite design on the printing plate surface have a depth between 20 and 130 microns.

18. The intaglio printing method as set forth in claim 12, wherein the lines of said composite design have a pitch of between 30 and 200 lines per inch.

19. The intaglio printing method as set forth in claim 12, wherein the lines of said composite design have a width of .002 to .003 inches.

20. The intaglio printing method as set forth in claim 12, wherein the reflective ink comprises 25% by weight aluminum.

21. The intaglio printing method as set forth in claim 12, wherein the reflective ink contains mother of pearl.

22. The intaglio printing method as set forth in claim 12, wherein the lines of the composite design on the printing plate surface have a depth between 20 and 130 microns.

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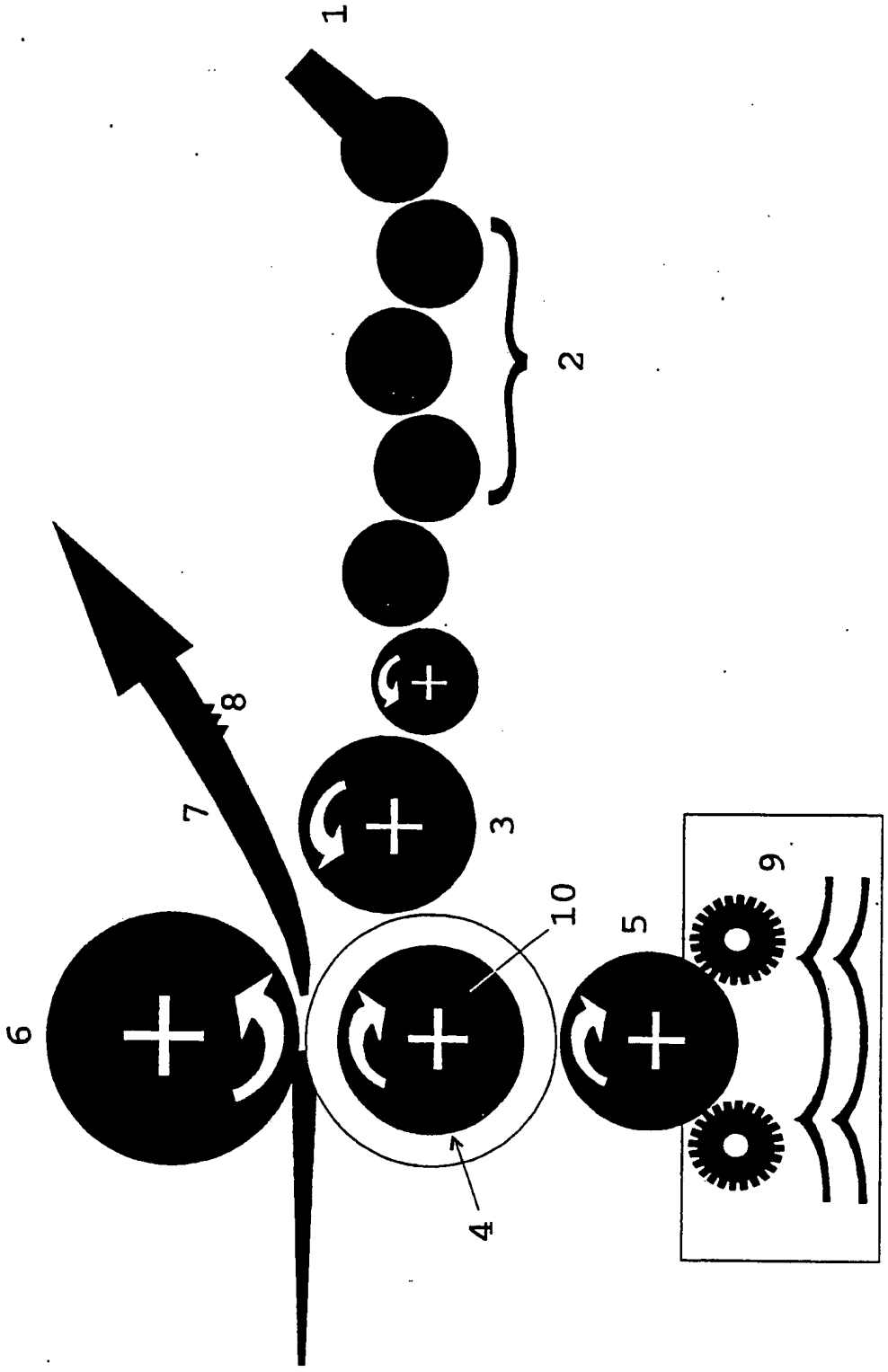



FIG. 1 (PRIOR ART)

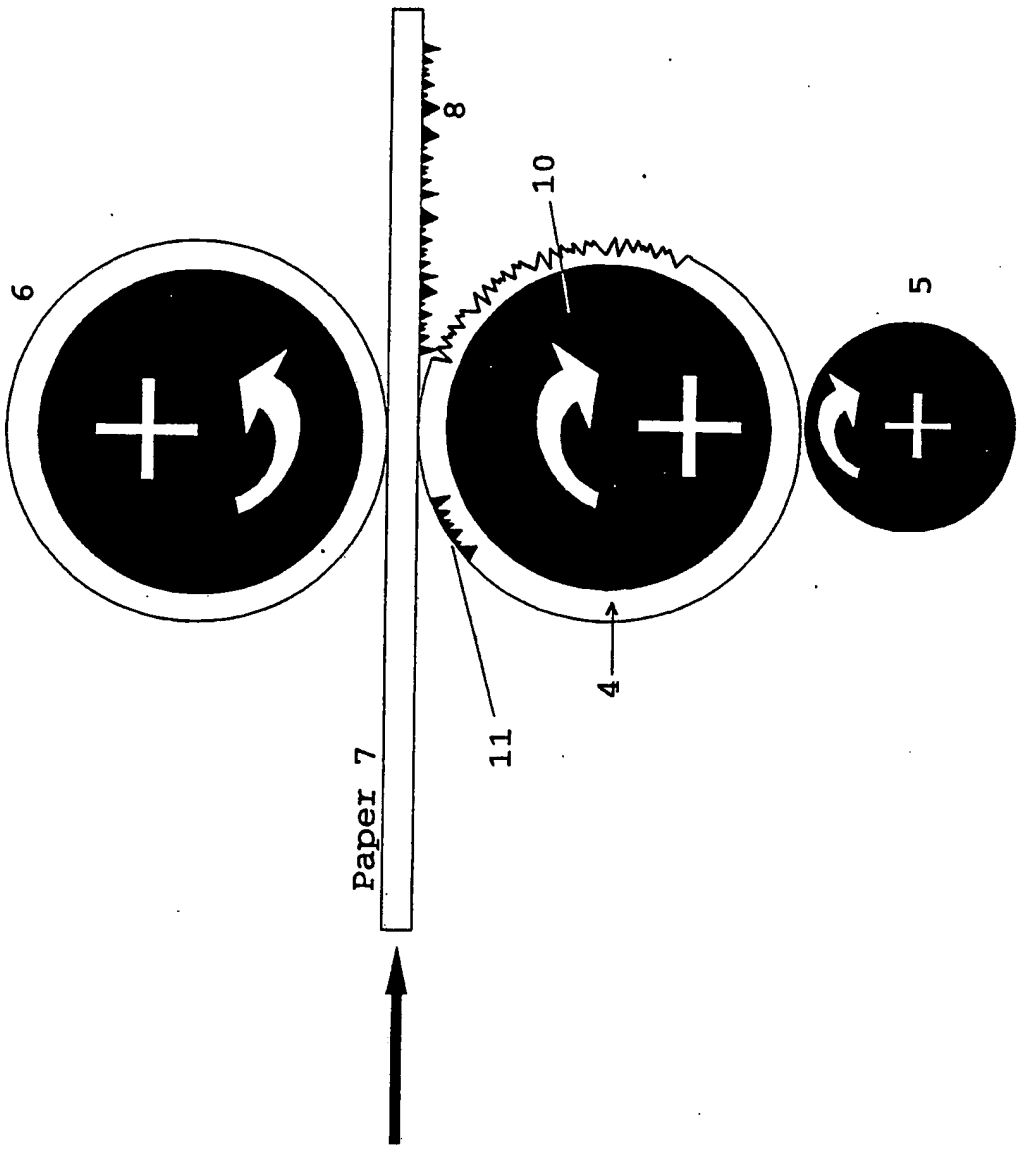



FIG. 2 (PRIOR ART)

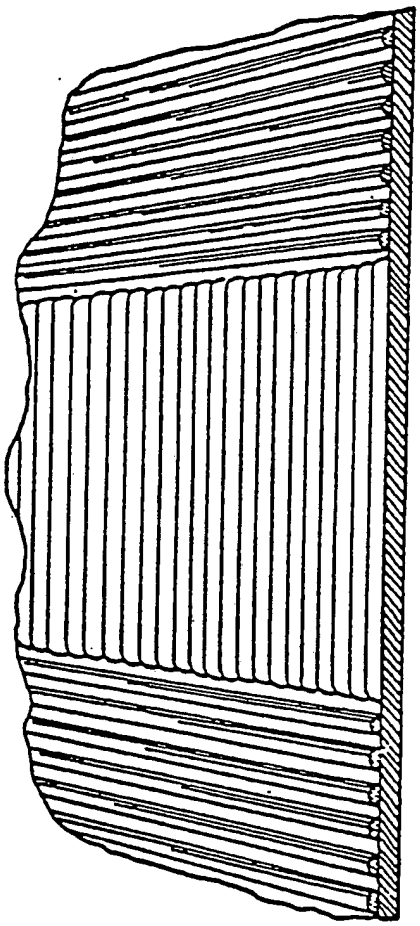


FIG. 3A

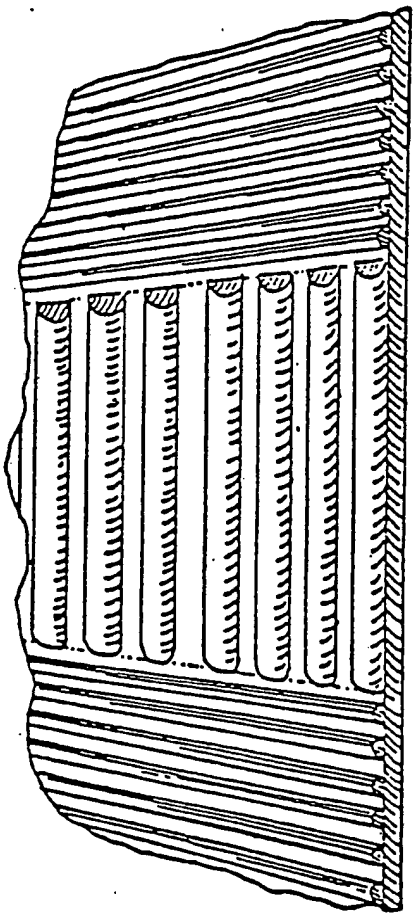


FIG. 3B

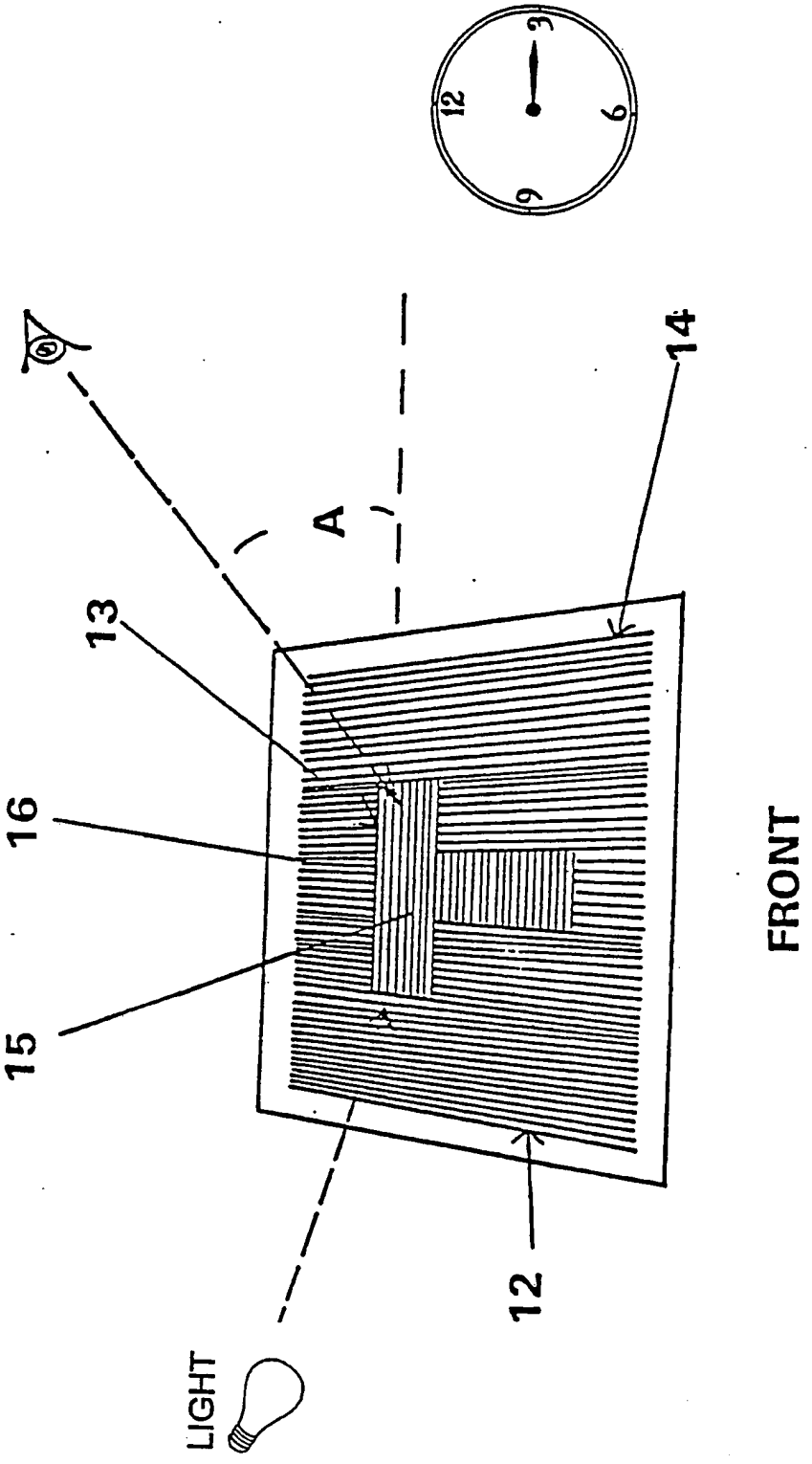



FIG. 4

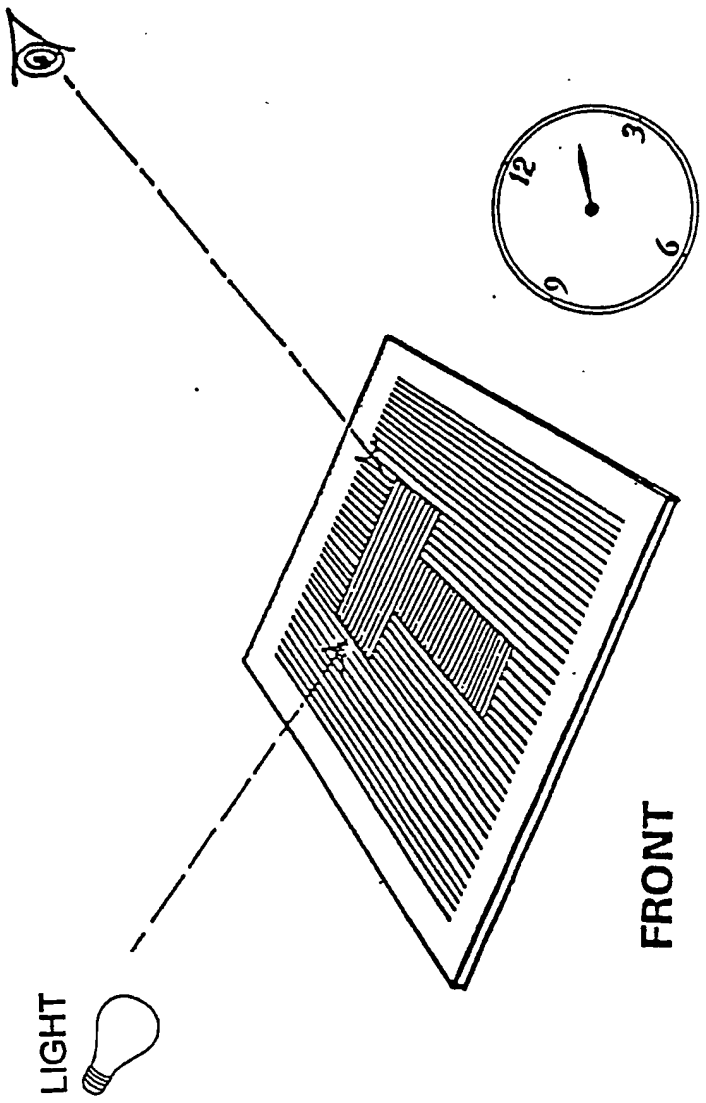



FIG. 5

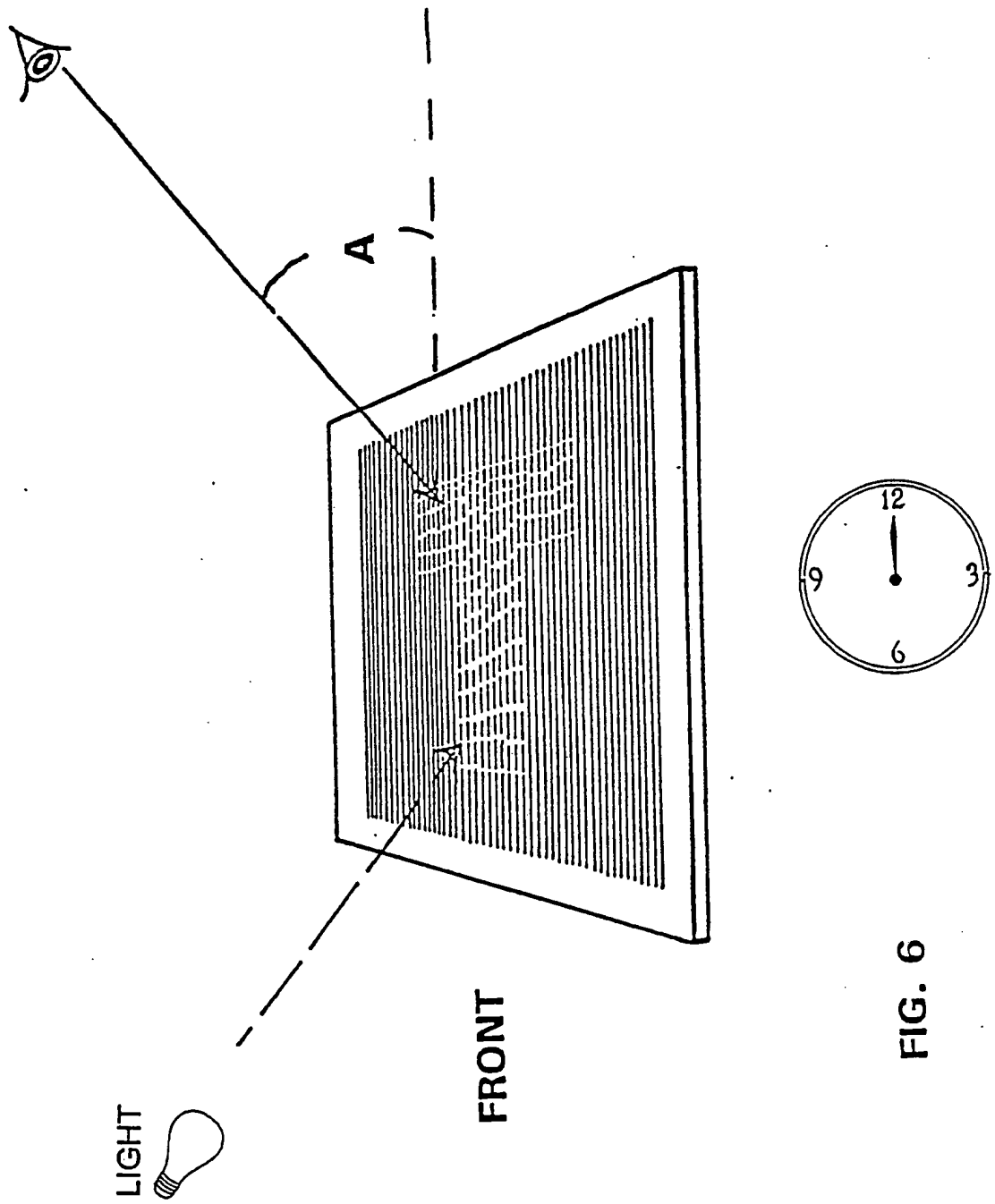



FIG. 6